Chapter Seventeen

Statistics

Owing to the contribution of information and data, the world has become a global village for the rapid advancement of science and information. Globalization has been made possible due to rapid transformation and expansion of information and data. So, to keep the continuity of development and for participating and contribute in globalizations, it is essential for the students at this stage to have clear knowledge about information and data. In the context, to meet the demands of students in acquiring knowledge, information and data have been discussed from class VI and class-wise contents have been arranged step by step. In continuation of this, the students of this class will know and learn cumulative frequency, frequency polygon, ogive curve in measuring of central tendency mean, median, mode etc. in short-cut method.

At the end of this chapter, the students will be able to -

- Explain cumulative frequency, frequency polygon and ogive curve;
- Explain data by the frequency polygon, and ogive curve ;
- Explain the method of measuring of central tendency ;
- Explain the necessity of short-cut method in the measurement of central tendency ;
- Find the mean, median and mode by the short-cut method ;
- Explain the diagram of frequency polygon and ogive curve.

Presentation of Data : We know that numerical information which are not qualitative are the data of statistics. The data under investigation are the raw materials of statistics. They are in unorganized form and it is not possible to take necessary decision directly from the unorganized data. It is necessary to organize and tabulate the data. And the tabulation of data is the presentation of the data. In previous class we have learnt how to organize the data in tabulation. We determine know that it is required to the range of data for tabulation. Then determining the class interval and the number of classes by using tally marks, the frequency distribution table is made. Here, the methods of making frequency distribution table are to be re-discussed through example for convenient understanding.

Example 1. In a winter season, the temperature (in celsius) of the month of January in the district of Srimangal is placed below. Find the frequency distribution table of the temperature.

14°, 14°, 14°, 13°, 12°, 13°, 10°, 10°, 11°, 12°, 11°, 10°, 9°, 8°, 9°,
11°, 10°, 10°, 8°, 9°, 7°, 6°, 6°, 6°, 6°, 7°, 8°, 9°, 9°, 8°, 7°.

Solution : Here the minimum and maximum numerical values of the data of temperature are 6 and 14 respectively.
Hence the range = 14 – 6 + 1 = 9.

If the class interval is considered to be 3, the numbers of class will be $\frac{9}{3}$ or, 3.

Considering 3 to be the class interval, if the data are arranged in 3 classes, the frequency table will be :

Temperature (in celcius)	Tally	Frequency
6° – 8°	~~llll~~ ~~llll~~ l	11
9° – 11°	~~llll~~ ~~llll~~ lll	13
12° – 14°	~~llll~~ ll	7
		Total = 31

Activity : Form two groups of all the students studying in your class. Find the frequency distribution table of the weights (in Kgs) of all the members of the groups.

Cumulative Frequency :
In example1, considering 3 the class interval and determining the number of classes, the frequency distribution table has been made. The numbers of classes of the mentioned data are 3. The limit of the first class is 6° – 8°. The lowest range of the class is 6^{o} and the highest range is 8^{o}C. The frequency of this class is 11.
The frequency of the second class is 13. Now if the frequency 11 of first class is added to the frequency 13 of the second class, we get 24. This 24 will be the cumulative frequency of the second class and the cumulative frequency of first class as begins with the class will be 11. Again, if the cumulative frequency 24 of the second class is added to the frequency of the third class, we get 24 + 7 = 31 which is the cumulative frequency of the third class. Thus cumulative frequency distribution table is made. In the context of the above discussion, the cumulative frequency distribution of temperature in example 1 is as follow :

Temperature (in celsius)	Frequency	Cumulative Frequency
6° – 8°	11	11
9° – 11°	13	(11 + 13) = 24
12° – 14°	7	(24 + 7) = 31

Example 2. The marks obtained in English by 40 students in an annual examination are given below. Make a cumulative frequency table of the marks obtained.
70, 40, 35, 60, 55, 58, 45, 60, 65, 80, 70, 46, 50, 60, 65, 70, 58, 69, 48, 70, 36, 85, 60, 50, 46, 65, 55, 61, 72, 85, 90, 68, 65, 50, 40, 56, 60, 65, 46, 76.

Solution : Range of the data = (highest numerical value − lowest numerical value) + 1

$= (90 - 35) + 1$

$= 55 + 1$

$= 56$

Let the class interval be 5, the number of classes $= \frac{56}{5}$

$= 11 \cdot 2$ or 12

Hence the cumulative frequency distribution table at a class interval of 5 will be as follow :

Obtained marks	Frequency	Cumulative frequency	Obtained marks	Frequency	Cumulative frequency
35 – 39	2	2	70 – 74	4	4 + 31 = 35
40 – 44	2	2 + 2 = 4	75 – 79	1	1 + 35 = 36
45 – 49	5	5 + 4 = 9	80 – 84	1	1 + 36 = 37
50 – 54	3	3 + 9 = 12	85 – 89	2	2 + 37 = 39
55 – 59	5	5 + 12 = 17	90 – 94	1	1 + 39 = 40
60 – 64	8	8 + 17 = 25	95 – 99	0	0 + 40 = 40
65 – 69	6	6 + 25 = 31			

Variable : We know that the numerical information is the data of statistics. The numbers used in data are variable. Such as, the numbers indicating temperatures are variable. Similarly, in example 2, the secured marks used in the data are the variables.

Discrete and Indiscrete Variables : The variables used in statistics are of two types. Such as, discrete and indiscrete variables. The variables whose values are only integers, are discrete variables. The marks obtained in example 2 are discrete variables. Similarly, only integers are used in population indicated data. That is why, the variables of data used for population are discrete variables. And the variables whose numerical values can be any real number are indiscrete variables. Such as, in example 1, the temperature indicated data which can be any real number. Besides, any real number can be used for the data related to age, height, weight etc. That is why, the variables used for those are indiscrete variables. The number between two indiscrete variables can be the value of those variables. Some times it becomes necessary to make class interval indiscrete. To make the class interval indiscrete, the actual higher limit of a class and the lower limit of the next class are determined by fixing mid-point of a higher limit of any class and the lower limit of the next class. Such as, in example 1 the actual higher-lower limits of the first class are $8 \cdot 5^\circ$ and $5 \cdot 5^\circ$ respectively and that of the second class are $11 \cdot 5^\circ$ and $8 \cdot 5^\circ$ etc.

Activity : Form a group of maximum 40 students of your class. Form frequency distribution table and cumulative frequency table of the group with the weights/heights of the members.

Diagram of Data : We have seen that the collected data under investigation are the raw materials of the statistics. If the frequency distribution and cumulative frequency distribution table are made with them, it becomes clear to comprehend and to draw a conclusion. If that tabulated data are presented through diagram, they become easier to understand as well as attractive. That is why, presentation of statistical data in tabulation and diagram is widely and frequently used method. In class VIII, different types of diagram in the form of line graph and histogram have been discussed elaborately and the students have been taught how to draw them. Here, how frequency polygon, pie-chart, ogive curve drawn from frequency distribution and cumulative frequency table will be discussed.

Frequency Polygon : In class VIII, we have learnt how to draw the histogram of discrete data. Here how to draw frequency polygon from histogram of indiscrete data will be put for discussion through example.

Example 3. The frequency distribution table of the weights (in kg) of 60 students of class X of a school are is follows :

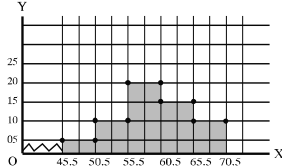
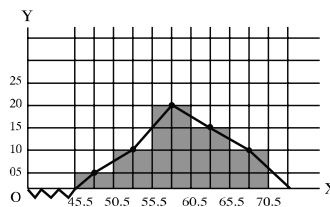
Weight (in kg)	46 – 50	51 – 55	56 – 60	61 – 65	66 – 70
Frequency (No of Students)	5	10	20	15	10

(a) Draw the histogram of frequency distribution.

(b) Draw frequency polygon of the histogram.

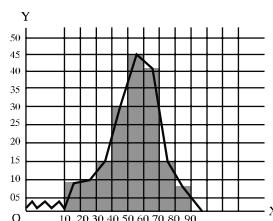
Solution : The class interval of the data in the table is discrete. If the class interval are made indiscrete, the table will be :

Class interval of the weight (in kg)	**Discrete class interval**	**Mid point of class**	**Frequency**
46 – 50	45·5 – 50·5	48	5
51 – 55	50·5 – 55·5	53	10
56 – 60	55·5 – 60·5	58	20
61 – 65	60·5 – 65·5	63	15
66 – 70	65·5 – 70·5	68	10

(a) Histogram has been drawn taking each square of graph paper as unit of class interval along with x-axis and frequency along with y-axis. The class interval along with x-axis has started from. The broken segments have been used to show the presence of previous squares starting from from origin to 45·5.

(b) The mid-points of the opposite sides parallel to the base of rectangle of the histogram have been fixed for drawing frequency polygon from histogram. The mid-points have been joined by line segments to draw the frequency polygon (shown in the adjacent figure). The mid-points of the first and the last rectangles have been joined with x-axis representing the class interval by the end points of line segments to show the frequency polygon attractive.

Frequency Polygon : The diagram drawn by joining frequency indicated points opposite to the class interval of indiscrete data by line segments successively is frequency polygon.

Example 4. Draw polygon of the following frequency distribution table :

Class interval	10–20	20–30	30–40	40–50	50–60	60–70	70–80	80–90
Mid-point	15	25	35	45	55	65	75	85
Frequency	8	10	15	30	45	41	15	7

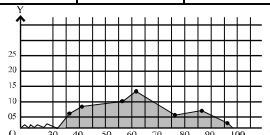
Solution : Histogram of frequency distribution is drawn taking two squares of graph paper as 5 units of class interval along with x-axis and 2 squares of graph paper as 5 units of frequency along with y-axis. The mid-points of the sides opposite to the base of rectangle of histogram are identified which are the mid-points of the class. Now the fixed mid-points are joined. The end-points of the first and the last classes are joined to x-axis representing the class interval to draw frequency polygon.

Activity : Draw frequency polygon from the marks obtained in Bangla by the students of your class in first terminal examination.

Example 5. The frequency distribution table of the marks obtained by 50 students of class X in science are given. Draw the frequency polygon of the data (without using histogram) :

Class interval of marks obtained	31–40	41–50	51–60	61–70	71–80	81–90	91–100
Frequency	6	8	10	12	5	7	2

Solution : Here the given data are discrete. In this case, it is convenient to draw frequency polygon directly by finding the mid-point of class interval.

Class interval	31–40	41–50	51–60	61–70	71–80	81–90	91–100
Mid-point	$\frac{40+31}{2}$ $=35\cdot5$	45·5	55·5	65·5	75·5	85·4	95·5
Frequency	6	8	10	12	5	7	2

The polygon is drawn by taking 2 squares of graph paper as 10 units of mid-points of class interval along with x-axis and taking two squares of graph paper as one units of frequency along with y-axis.

Activity : Draw frequency polygon from the frequency distribution table of heights of 100 students of a college.

Heights (in cm.)	141–150	151–160	161–170	171–180	181–190
Frequency	5	16	56	11	4

Cumulative Frequency Diagram or Ogive curve : Cumulative frequency diagram or Ogive curve is drawn by taking the upper limit of class interval along with x-axis and cumulative frequency along with y-axis after classification of a data

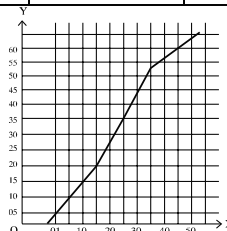
Example 6. The frequency distribution table of the marks obtained by 50 students out of 60 students is as follow :

Class interval of marks obtained	1 – 10	11 – 20	21 – 30	31 – 40	41 – 50
Frequency	8	12	15	18	7

Draw the Ogive curve of this frequency distribution.

Solution : The cumulative frequency table of frequency distribution of the given data is :

Class interval of marks obtained	1 – 10	11 – 20	21 – 30	31 – 40	41 – 50
Frequency	8	12	15	18	7
Cumulative frequency	8	$8+12=20$	$15+20=35$	$18+35=53$	$7+53=60$

Ogive curve of cumulative frequency of data is drawn taking two squares of graph paper as unit of upper limit of class interval along with x-axis and one square of graph paper as 5 units of cumulative frequency along with y-axis.

Activity : Make cumulative frequency table of the marks obtained 50 and above in Mathematics by the students of your class in an examination and draw an Ogive curve.

Central Tendency : Central tendency and its measurement have been discussed in class VI and VII. We have seen if the data under investigation are arranged in order of values, the data cluster round near any central value. Again if the disorganized data are placed in frequency distribution table, the frequency is found to be abundant in a middle class i.e. frequency is maximum in middle class. In fact, the tendency of data to be clustered around the central value is number and it represents the data. The central tendency is measured by this number. Generally, the measurement of central tendency is of three types (1) Arithmetic means (2) Median (3) Mode :

Arithmetic Mean : We know if the sum of data is divided by the numbers of the data, we get the arithmetic mean. But this method is complex, time consuming and there is every possibility of committing mistake for large numbers of data. In such cases, the data are tabulated through classification and the arithmetic mean is determined by short-cut method.

Example 7. The frequency distribution table of the marks obtained by the students of a class is as follows. Find the arithmetic mean of the marks.

Class interval	25–34	35–44	45–54	55–64	65–74	75–84	85–94
Frequency	5	10	15	20	30	16	4

Solution : The class interval is given and that is why it is not possible to know the individual marks of the students. In such case, it becomes necessary to know the mid-value of the class.

Mid-value of the class = $\frac{\text{Class upper value} + \text{class lower value}}{2}$

If the class mid-value is $x_1 (i = 1, \; ...., k)$, the mid-value related table will be as follows:

Class interval	**Class mid-value** x_i	**Frequency** f_i	$f_i x_i$
25 – 34	29·5	5	147·5
35 – 44	39·5	10	395·0
45 – 54	49·5	15	742·5
55 – 64	59·5	20	1190·0
65 – 74	69·5	30	2085·0
75 – 84	79·5	16	1272·0
85 – 94	89·5	4	358·0
	Total	100	6190·0

The required mean = $\frac{1}{n}\sum_{i=1}^{k} f_i x_i$

$= \frac{1}{100} \times 6190$

$= 61 \cdot 9.$

Arithmetic mean of classified data (short-cut method)

The short-cut method is easy for determining arithmetic mean of classified data.

The steps to determine mean by short-cut method are :

1. To find the mid-value of classes.
2. To take convenient approximated mean (a) from the mid-values.
3. To determine steps deviation, the difference between class mid-values and approximate mean are divided by the class interval i.e.

   $u = \frac{\text{mid value} - \text{approximate mean}}{\text{class interval}}$
4. To multiply the steps deviation by the corresponding class frequency.
5. To determine the mean of the deviation and to add this mean with approximate mean to find the required mean.

Short-cut method : The formula used for determining the mean of the data by this method is $\bar{x} = a + \frac{1}{n}\sum f_i u_i \times h$ where $\bar{x}$ is required mean, a is approximate mean, The f_i is class frequency of ith class, $u_i f_i$ is the product of step deviation with class intervals of ith class and h is class interval.

Example 8. The production cost (in hundred taka) of a commodity at different stages is shown in the following table. Find the mean of the expenditure by short-cut method.

Production cost (in hundred taka)	2-6	6-10	10-14	14-18	18-22	22-26	26-30	30-34
Frequency	1	9	21	47	52	36	19	3

Solution : To determine mean in the light of followed steps in short-cut method, the table will be :

Class interval	**Mid-value** x_i	**Frequency** f_i	**Step deviation** $u_i = \frac{x_i - a}{h}$	**Frequency and class interval** $f_i u_i$
2 – 6	4	1	– 4	– 4
6 – 10	8	9	– 2	– 27
10 – 14	12	21	– 3	– 42
14 – 18	16	47	– 1	– 47
18 – 22	20 a	52	0	0
22 – 26	24	36	1	36
26 – 30	28	19	2	38
30 – 34	32	3	3	9
Total		188		– 37

Mean $\bar{x} = a + \frac{\sum f_i u_i}{n} \times h$

$= 20 + \frac{-37}{188} \times 4$

$= 20 - \cdot 79$

$= 19 \cdot 22$

$\therefore$ Mean production cost is Tk. 19·22 hundred.

Weighted mean : In many cases the numerical values $x_1, x_2, ..., x_n$ of statistical data under investigation may be influenced by different reasons /importance /weight. In such case, the values of the data $x_1, x_2, ... x_n$ along with their reasons/importance /weight $w_1, w_2, ... w_n$ are considered to find the arithmetic mean.

If the values of n numbers of data are $x_1, x_2, ... x_n$ and their weights are $w_1, w_2, ... w_n$, the weighted mean will be

$$\overline{x_w} = \frac{\sum_{i=1}^{n} x_i w_i}{\sum_{i=1}^{n} w_i}$$

Example 9. The rate of passing in degree Honours class and the number of students of some department of a University are presented in the table below. Find the mean rate of passing in degree honours class of those departments of the university.

Name of the department	Math	Statistics	English	Bangla	Zoology	Pol. Science
Rate of passing (in percentage)	70	80	50	90	60	85
Number of Students	80	120	100	225	135	300

Solution : Here, the rate of passing and the number of students are given. The weight of rate of passing is the number of students. If the variables of rate of passing are x and numerical variable of students is w, the table for determining the arithmetic mean of given weight will be as follows :

Department	x_i	w_i	$x_i \; w_i$
Math	70	80	5600
Statistics	80	120	9600
English	50	100	5000
Bangali	90	225	20250
Zoology	60	135	8100
Pol. Science	85	300	25500
Total		960	74050

$$\overline{x_w} = \frac{\sum_{i=1}^{6} x_i w_i}{\sum_{i=2}^{6} w_i} = \frac{74050}{960} = 77 \cdot 14$$

Mean rate of passing is 77·14

Activity : Collect the rate of passing students and their numbers in S.S.C. examination of some schools in your zilla and find mean rate of passing.

Median

We have already learnt in class VII the value of the data which divide the data when arranged in ascending order into two equal parts are median of the data. We have also learnt if the numbers of data are n and n is an odd number, the median will be the value of $\frac{n+1}{2}$ th term. But if n is an even number, the median will be numerical mean of the value of $\frac{n}{2}$ and $\left(\frac{n}{2}+1\right)$ th terms. Here we present through example how mean is determined with or without the help formulae.

Example 10. The frequency distribution table of 51 students is placed below. Find the median.

Height (in cm.)	150	155	160	165	170	175
Frequency	4	6	12	16	8	5

Solution : Frequency distribution table for finding mean is an follows :

Height (in cm.)	150	155	160	165	170	175
Frequency	4	6	12	16	8	5
Cumulative Frequency	4	10	22	38	46	51

Here, $n = 51$ which is an odd number.

$\therefore$ Median = the value of $\frac{51+1}{2}$ th term

= the value of 26 th term = 165

Required median is 165 c.m.

Note : The value of the terms from 23th to 38th is 165.

Example 11. The frequency distribution table of marks obtained in mathematics of 60 students is as follows. Find the median :

Marks obtained	40	45	50	55	60	70	80	85	90	95	100
Frequency	2	4	4	3	7	10	16	6	4	3	1

Solution : Cumulative frequency distribution table for determining median is :

Marks obtained	40	45	50	55	60	70	80	85	90	95	100
Frequency	2	4	4	3	7	10	16	6	4	3	1
Cumulative frequency	2	6	10	13	20	30	46	52	56	59	60

Here, $n = 60$ which is an even number.

$$\therefore \text{Median} = \frac{\text{The sum of values of } \frac{60}{2} \text{th and } \frac{60}{2}+1 \text{th terms}}{2}$$

$$= \frac{\text{The sum of values of 30th and 31th terms}}{2}$$

$$= \frac{70+80}{2} = \frac{150}{2} = 75$$

$\therefore$ Required Median is 75.

Activity :	1. Make frequency distribution table of the heights (in cm.) of 49 students of your class and find the mean without using any formula. 2. From the above problem, deduct the heights of 9 students and then find the median of heights (in cm.) of 40 students.

Determining Median of Classified Data

If the number of classified data is n, the value of $\frac{n}{2}$th term of classified data is median. And the formula used to determine the median or the value of $\frac{n}{2}$th term is :

Median = $L + \left(\frac{n}{2} - F_c\right) \times \frac{h}{f_m}$, where L is the lower limit of the median class, n is the frequency, F_c is the cumulative frequency of previous class to median class, f_m is the frequency of median class and h is the class interval.

Example 12. Determine median from the following frequency distribution table :

Time (in sec.)	30–35	36–41	42–47	48–53	54–59	60–65
Frequency	3	10	18	25	8	6

Solution : Frequency distribution table for determining median :

Time (in sec.) (class interval)	**Frequency**	**Cumulative Frequency**
30 – 35	3	3
36 – 41	10	13
42 – 47	18	31
48 – 53	25	56
54 – 59	8	64
60 – 65	6	70
	n = 70	

Here, $n = 70$ and $\frac{n}{2} = \frac{70}{2}$ or 35.

Therefore, median is the value of 35th term. 35th term lies in the class (48 –53). Hence the median class is (48 –53).

Therefore, $L = 48$, $F_c = 31$, $F_m = 25$ and $h = 6$.

Median $= L + \left(\frac{n}{2} - F_c\right) \times \frac{h}{f_m}$

$$= 48 + (35 - 31) \times \frac{6}{25} = 48 + 4 \times \frac{6}{25}$$
$$= 48 + 0 \cdot 96$$
$$= 48 \cdot 96$$

Required median is 48·96

Activity : Make two groups with all the students of your class. (a) Make a frequency distribution table of the time taken by each of you to solve a problem, (b) find the median from the table.

Mode :

In class VII, we have learned that the number which appears maximum times in a data is the mode of the data. In a data, there may be one or more than one mode. If there is no repetition of a member in a data, data will have no mode. Now we shall discuss how to determine the mode of classified data using formula.

Determining Mode of Classified Data

The formula used to determine the mode of classified data is :

Mode $= L + \frac{f_1}{f_1 + f_2} \times h$, where L is the lower limit of mode-class i.e. the class where the mode lies, $f_1 =$ frequency of mode-class – frequency of the class previous to mode class, $f_2 =$ frequency of mode class – frequency of next class of mode class and $h =$ class interval.

Example 13. Find the mode from the following frequency distribution table.

Class	Frequency
31 – 40	4
41 – 50	6
51 – 60	8
61 – 70	12
71 – 80	9
81 – 90	7
91 – 100	4

Solution

Mode $= L + \frac{f_1}{f_1 + f_2} \times h$

Here, the maximum numbers of repetition of frequency is 12 which lies in the class (61 – 70). Hence, $L = 61$

$f_2 = 12 - 8 = 4$
$f_2 = 12 - 9 = 3$
$h = 10$

$\therefore$ Mode $= 61 + \frac{4}{4+3} \times 10 = 61 + \frac{4}{7} \times 10$

$= 61 + \frac{40}{7} = 61 + 5 \cdot 7 = 66 \cdot 7$

Therefore, the required mode is $66 \cdot 714$

Example 14. Find the mode from the frequency distribution table below :

Class	Frequency
41 – 50	25
51 – 60	20
61 – 70	15
71 – 80	8

Solution : Here, maximum numbers of frequency are 25 which lie in the class (41–50). So it is evident that mode is in this class. We know that

Mode $= L + \frac{f_1}{f_1 + f_2} \times h$

Here, $L = 41$ [If the frequency is maximum in the first class, the frequency of previous class is zero]

$f_1 = 25 - 0$

$f_2 = 25 - 20 = 5$

$\therefore$ Mode $= 41 + \frac{25}{25+5} \times 10$

$= 41 + \frac{25}{30} \times 10 = 51 + 8 \cdot 33$

$= 49 \cdot 33$

Therefore, required mode is $49 \cdot 33$

In classified data, if the first class is mode class the frequency of previous class is considered to be zero.

Example 15. Determine the mode of the following frequency distribution table :

Class	Frequency
10 – 20	4
21 – 30	16
31 – 40	20
41 – 50	25

Solution : The maximum numbers of frequency are 25 which lie in the class (41 – 50). So it is obvious that this class is the class of mode. We know that,

Mode $= L + \frac{f_1}{f_1 + f_2} \times h$

Here, $L = 41$

$f_1 = 25 - 20 = 5$

$h = 10$

Therefore, mode $= 41 + \frac{5}{25} \times 10$

$= 41 + 2 = 43$

The required mode is 43.

Exercise 17

Put tick (√) mark in the correct answer :

1. Of the following, which one is class interval ?
   (a) The difference between the highest and the lowest data
   (b) The difference between the first and the last data
   (c) The difference between the highest and the lowest number of each class
   (d) The sum of the highest and the lowest numbers of each class.
2. Which one indicates the data included in each class when the data are classified?
   (a) Class limit (b) Mid-point of the class
   (c) Numbers of classes (d) Class frequency
3. If the disorganized data of statistics are arranged according to the value, the data cluster round near any central value. This tendency of data is called
   (a) mode (b) cetral tendency (c) mean (d) median

   In winter, the statistics of temperatures (in celsius) of a region in Bangladesh is 10°, 9°, 8°, 6°, 11°, 12°, 7°, 13°, 14°, 5°. In the context of this statistics, answer the questions from (4 -6).

4. Which is the mode of the above numerical data ?
   (a) 12° (b) 5° (c) 14° (d) no mode
5. Which one is the mean of temperature of the above numerical data ?
   (a) 8° (b) 8.5° (c) 9.5° (d) 9°
6. Which one is the median of the data ?
   (a) 9.5° (b) 9° (c) 8.5° (d) 8°
7. The number of classified data included in the table is n, the lower limit of median class is L, the cumulative data of previous class to median class is F_c, the frequency of median class is f_m and class interval is h. In the light of these information, which one is the formula for determining the median ?
   (a) $L + \left(\frac{n}{2} - F_c\right) \times \frac{h}{f_m}$ (b) $L + \left(\frac{n}{2} - f_m\right) \times \frac{h}{F_m}$
   (c) $L - \left(\frac{n}{2} - F_c\right) \times \frac{h}{f_m}$ (d) $L - \left(\frac{n}{2} - f_n\right) \times \frac{h}{F_m}$

Class Interval	31–40	41–50	51–60	61–80	71–80	81–90	91–100
Frequency	6	12	16	24	12	8	2
Cumulative Frequency	6	18	34	58	70	78	80

8. In how many classes have the data been arranged ?
   (a) 6 (b) 7 (c) 8 (d) 9
9. What is the class interval of the data presented in the table ?
   (a) 5 (b) 9 (c) 10 (d) 15
10. What is the mid value of the 4th class ?
    (a) 71.5 (b) 61.5 (c) 70.5 (d) 75.6
11. Which one is the median class of the data ?
    (a) 41–50 (b) 51–60 (c) 61–70 (d) 71–80
12. What is the cumulative frequency of the previous class to the median class ?
    (a) 18 (b) 34 (c) 58 (d) 70
13. What is the lower limit of median class ?
    (a) 41 (b) 51 (c) 61 (d) 71
14. What is the frequency of median class ?
    (a) 16 (b) 24 (c) 34 (d) 58
15. What is the median of the presented data?
    (a) 63 (b) 63.5 (c) 65 (d) 65.5
16. What is the mode of the presented data ?
    (a) 61.4 (b) 61 (c) 70 (d) 70.4
17. The weights (in kg) of 50 students of class X of a school are :
    45, 50, 55, 51, 56, 57, 56, 60, 58, 60, 61, 60, 62, 60, 63, 64, 60,
    61, 63, 66, 67, 61, 70, 70, 68, 60, 63, 61, 50, 55, 57, 56, 63, 60,
    62, 56, 67, 70, 69, 70, 69, 68, 70, 60, 56, 58, 61, 63, 64.
    (a) Make frequency distribution table considering 5 as a class interval.
    (b) Find the mean from the table in short-cut method.
    (c) Draw frequency polygon of the presented data in frequency distribution table.
18. Frequency distribution table of the marks obtained in mathematics of 50 students of class X are provided. Draw the frequency polygon of the provided data.

Class interval	31–40	41–50	51–60	61–70	71–80	81–90	91–100
Frequency	6	8	10	12	5	7	2

19. The frequency distribution table of a terminal examination in 50 marks of 60 students of a class is as follows :

Marks obtained	1–10	11–20	21–30	31–40	41–50
Frequency	7	10	16	18	9

Draw an Ogive curve of the data.

20. The frequency distribution table of weights (in kg) are provided below. Determine the median.

Weight (kg)	45	50	55	60	65	70
Frequency	2	6	8	16	12	6

21. The frequency distribution table of weights (in kg) of 60 students of a class are:

Interval	45-49	50-54	55-59	60-64	65-69	70-74
Frequency	4	8	10	20	12	6
Cumulative Frequency	4	12	22	42	54	60

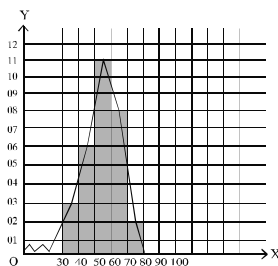
(a) Find the median of the data.
(b) Find the mode of the data.

22. In case of data, Mode is-
(i) Measures of central tendency
(ii) Represented value which is mostly occured
(iii) May not unique in all respect
Which is correct on the basis of above information?
a) i and ii b) i and iii
c) ii and iii d) i, ii, and iii

23. The following are the marks obtained in Mathematics of fifty students of class IX in a school :

76, 65, 98, 79, 64 68, 56, 73, 83, 57
55, 92, 45, 77, 87 46, 32, 75, 89, 48
97, 88, 65, 73, 93 58, 41, 69, 63, 39
84, 56, 45, 73, 93 62, 67, 69, 65, 53
78, 64, 85, 53, 73 34, 75, 82, 67, 62

(a) What is the type of the given information? What indicate frequency in a class of distribution?
(b) Make frequency table taking appropiate class enterval.
(c) Determine the mean of the given number by shortcut method.

24.

(a) In the above figure, what is class midvalue?
(b) Express by data of information demonstrated in the figure (b).
(c) Find the median of frequency obtained from (b).